
The contribution of the SOLCON instrument to the long term Total Solar Irradiance observation

S. Dewitte, A. Joukoff, D. Crommelynck, RMIB

R. B. Lee III, NASA LARC

R. Helizon, JPL

Overview

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0. Objective

- ◆ long term observation of Total Solar Irradiance, important for global climate change studies
- ◆ has to be done from space
- ◆ is a challenge due to drifts and limited instrument lifetimes

1. The SOLCON type radiometer

- ◆ 2 symmetrical cavities for the measurement of the absorbed solar radiation
- ◆ heat flux sensors between cavities and heat sink
- ◆ electrical resistances in the cavities for electrical power calibration
- ◆ servo system to obtain equilibrium between cavities
- ➡ works as “thermal pair of scales”

Irradiance determination

- ◆ simple approximation $SI = (P_{\text{closed}} - P_{\text{open}})/A$
- ◆ corrections needed
 - thermal emission shutters
 - absorption cavity
 - efficiency cavity
 - diffraction
 - ...

2. Observations during the IEH-3 mission

- ◆ flight from 29/10/1998 to 7/11/1998
- ◆ solar observation during 11 dedicated + 7 non dedicated solar periods
- ◆ reduction measured irradiance to 1 A.U.

$$S = S_I / r_{\text{sun-shuttle}}^2$$

$r_{\text{sun-shuttle}}$ = distance earth shuttle in A.U.
determined from position earth relative to sun and shuttle relative to earth

3. Determination of the VIRGO SARR coefficients

- ◆ SARR = ensemble of instrument adjustment coefficients a to relate them to common reference
- ◆ SARR adjusted SOLCON measurements:
 $a_{\text{SOLCON-L}} S_{\text{SOLCON-L}}(t)$, $a_{\text{SOLCON-R}} S_{\text{SOLCON-R}}(t)$
- ◆ original measurements VIRGO radiometers:
 $S_{\text{DIARAD-L}}(t)$, $S_{\text{PMO-VA}}(t)$
- ◆ SARR coefficient = ratio of means

3. Determination of the VIRGO SARR coefficients *(continued)*

$$a_{\text{DIARAD-L}} = a_{\text{SOLCON-L/R}} \frac{\overline{S_{\text{SOLCON-L}}(t)}}{\overline{S_{\text{DIARAD-L}}(t)}} \\ = 1.000025$$

$$a_{\text{PMO-VA}} = a_{\text{DIARAD-L}} \frac{\overline{S_{\text{DIARAD-L}}(t)}}{\overline{S_{\text{PMO-VA}}(t)}} \\ = 1.000279$$

4. Verification aging ERBS radiometer

- ◆ ERBS radiometer = measures solar irradiance since 1985
- ◆ SARR adjustment coefficient was defined during ATLAS 2 shuttle flight
- ➔ comparison SARR adjusted ERBS and VIRGO measurements provides verification of the ageing between ATLAS 2 (April 1993) and IEH 3 (October/November 1998)

4. Verification aging ERBS radiometer *(continued)*

- ◆ $a_{\text{ERBS}} \overline{S_{\text{ERBS}}(t)} / a_{\text{DIARAD-L}} \overline{S_{\text{DIARAD-L}}(t)} = 0.99993$
- ◆ $a_{\text{ERBS}} \overline{S_{\text{ERBS}}(t)} / a_{\text{PMO-VA}} \overline{S_{\text{PMO-VA}}(t)} = 0.99995$
- ◆ standard deviation ratio = 0.00014
- ➔ no significant ageing of ERBS

5. SARR solar irradiance

- ◆ available long term measurements
 - Nimbus-7 (1978-1992)
 - ACRIM I (1980-1989)
 - ERBS (1985-...)
 - ACRIM II (1991-...)
 - SOVA 1 (1992-1993)
 - SOVA 2 (1992-1993)
 - DIARAD/VIRGO (1996-...)
 - PMO/VIRGO (1996-...)

5. SARR solar irradiance *(continued)*

- ◆ SARR adjusted measurement single instrument

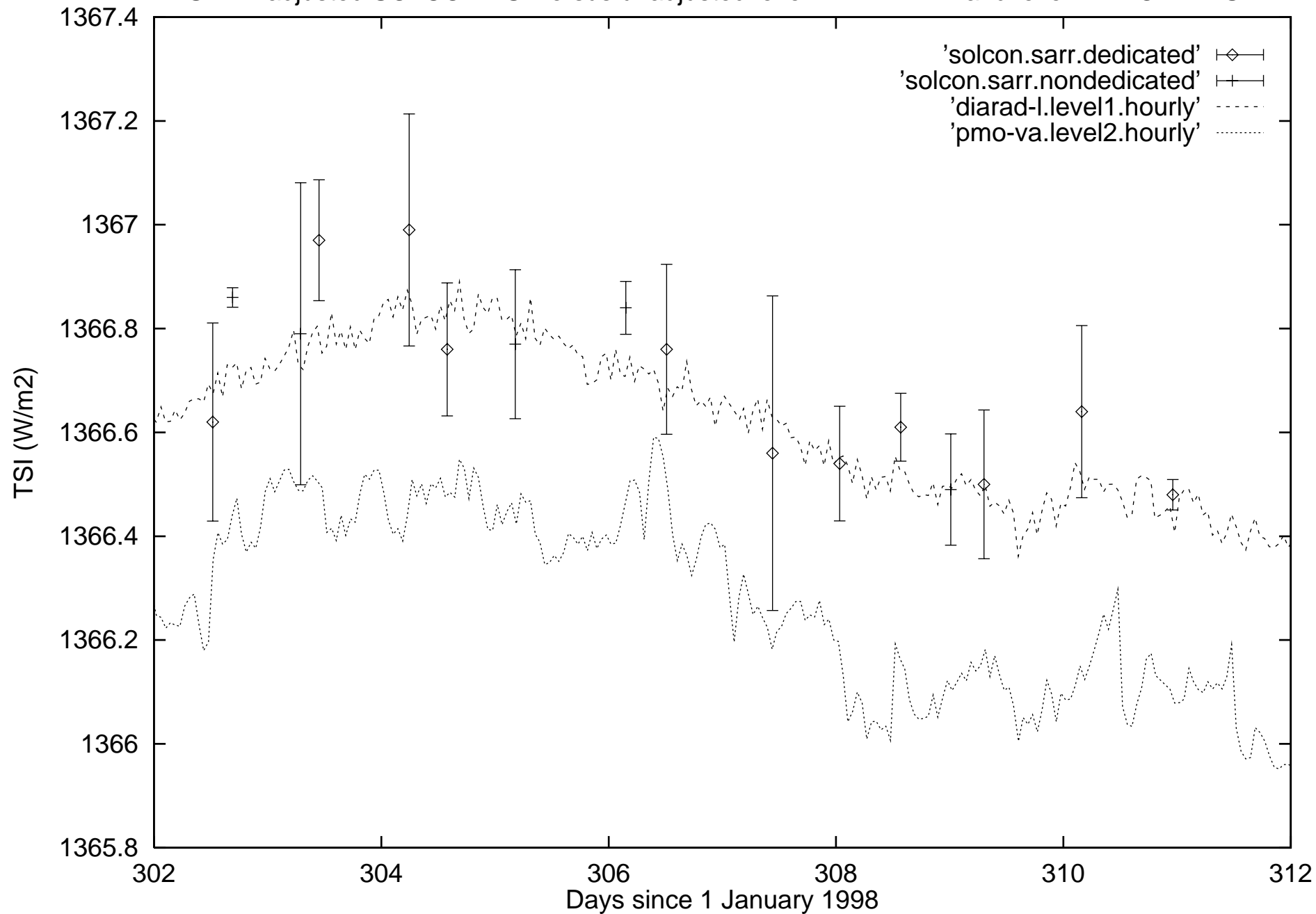
$$a_{\text{instrument}} S_{\text{instrument}} (t)$$

- ◆ SARR solar irradiance = mean of all available SARR adjusted measurements of individual instruments

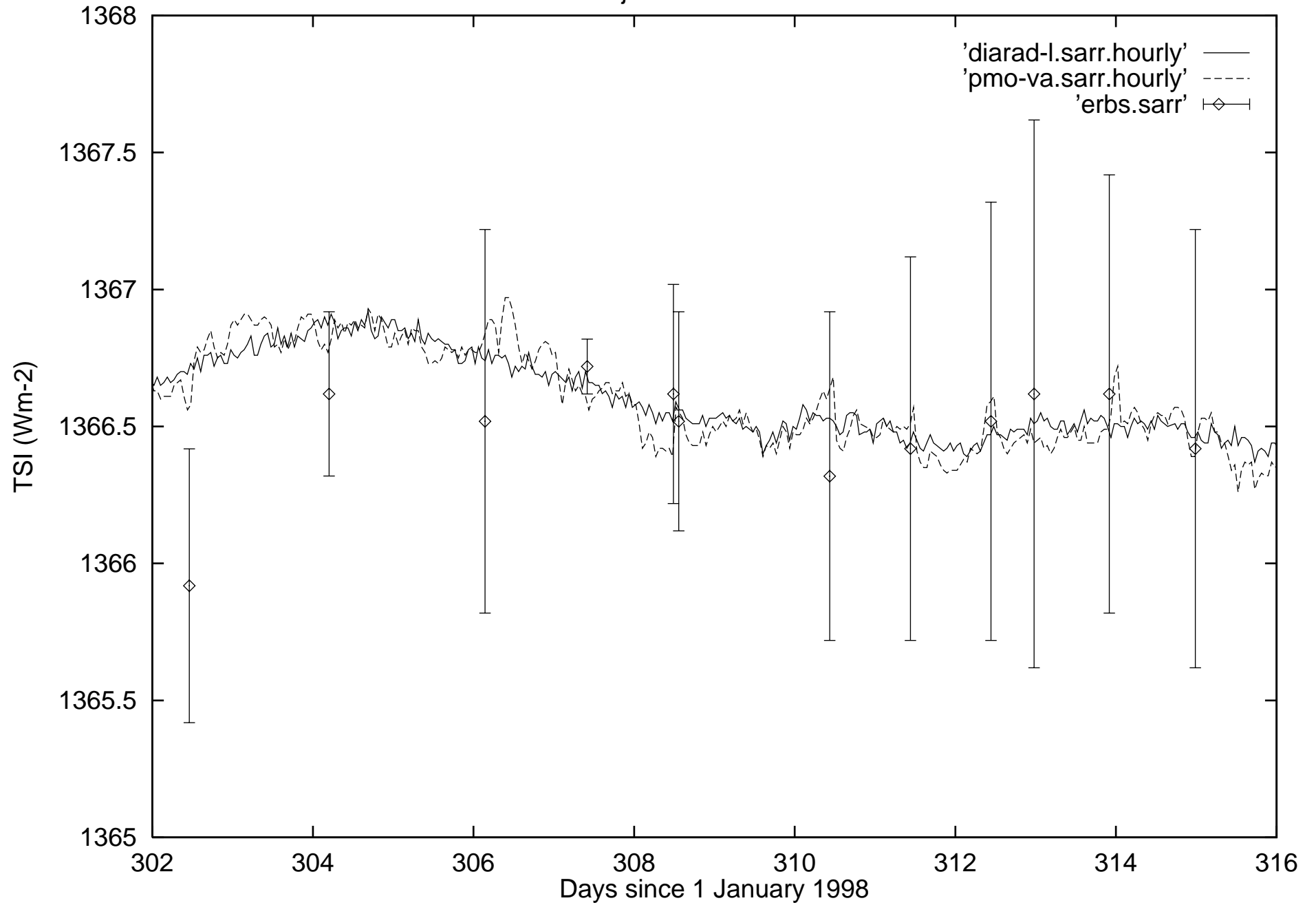
6. Conclusions

- ◆ The SOLCON measurements obtained during the IEH-3 flight were of good quality.
- ◆ They allowed the determination of the SARR coefficients for the VIRGO radiometers.
- ◆ They indicated that the ERBS radiometer did not age significantly between 1993 and 1998.
- ◆ A SARR solar irradiance from 1978 to the present has been obtained.

SARR adjusted SOLCON TSI versus unadjusted level 1 DIARAD-L and level 2 PMO-VA TSI"



SARR adjusted TSI measurements



SARR Total Solar Irradiance

